Summary Report

Second National Micronutrient Survey: Nicaragua, 2000

A Translation

MOST
The USAID Micronutrient Program

USAID

This publication was made possible through support provided by the Office of Health, Infectious Disease and Nutrition, of the Bureau for Global Health, U.S. Agency for International Development (USAID).

MOST is managed by the International Science and Technology Institute, Inc. (ISTI) under the terms of Cooperative Agreement No. HRN-A-00-98-0047-00. Partners are the Academy for Educational Development (AED), Helen Keller International (HKI), the International Food Policy Research Institute (IFPRI), and Johns Hopkins University (JHU). Resource institutions are CARE, the International Executive Service Corps (IESC), Population Services International (PSI), Program for Appropriate Technology in Health (PATH), and Save the Children.

MOST

1820 North Fort Myer Drive

Suite 600

Arlington, VA 22209 USA

Telephone 703.807.0236

Summary Report

Second National Micronutrient Survey: Nicaragua, 2000

A Translation

Survey supported by —

Republica de Nicaragua, Ministerio de Salud

United States Agency for International Development

UNICEF

Programa Modernizacion de Sector Salud

Instituto de Nutricion de Centro America y Panama

Pan American Health Organization

The Micronutrient Initiative

Centers for Disease Control

Acknowledgements

We wish to thank the Nicaraguan families that participated in this survey and the field staff for their dedication, enthusiasm and trust that enabled the completion of this important work. We also thank the laboratory personnel of the Institute of Nutrition of Central America and Panama (INCAP) in Guatemala City and of the National Diagnosis and Reference Center of the Nicaragua Ministry of Health who carried out the laboratory analysis of biological samples. We thank the staff of the Health Districts (SIVINs) for their collaboration in the fieldwork and the storage of laboratory samples. The technical and financial assistance agencies that supported the Nutrition Department of the Ministry of Health in conducting the survey are also recognized.

Preface

The Ministry of Health of Nicaragua is pleased to make available the results of the National Micronutrient Survey (NMS) carried out in 2000, which provides information about the evolution of the various micronutrient deficiencies considered to be problems of public health significance in Nicaragua.

I am sure that this effort will bear fruit and contribute to an improvement in the quality of life of the population, especially Nicaraguan children.

Lucia Salvo Horvilleur
Minister of Health
May 2002

Credits

Survey Personnel

Authorities from the Ministry of Health

Ms. Mariángeles Argüello
Minister of Health

Dr. Stanley Atha
Assistant Minister of Health

Dr. Miguel López Baldizón
Secretary General

Dr. Francisco Delgado
Director General of Health Services

Administrative Team

Dr. Antonio Largaespada, Director General, Department of Nutrition, MOH

Ms. Marta Ruiz, Coordinator, Field Work

Dr. Alejandra Narvaez, MOH

Dr. Josefina Bonilla, MOST Project-USAID

Dr. Fátima Ivette Sandino, UNICEF

Technical Assistance

Dr. José Mora, MOST-USAID

Dr. Omar Dary, INCAP-PAHO

Dr. Erick Boy, MI

Dr. Lawrence Grummer-Strawn, CDC

Dr. Jacky Knowles, CDC

Technical Collaborators

Dr. María Alejandra Bosche, USAID

Ms. Karla Arriola Mercado, Sampler-INEC

Ms. Carolina Martínez, INCAP-PAHO

Dr. Jeanette Chavarría, UNICEF

Dr. Tita Picado, PMSS

Ms. Carmen María Reyes, PMSS

Dr. Gloria Elena Navas, INCAP-PAHO

Processing and Analysis of Biological Samples

Dr. Alcides González, Director General, CNDR-MOH

Mr. Carlos Morales, CNDR-MOH

Ms. Yolanda Solórzano, CNDR-MOH

Nutrition Institute of Central America and Panama

Data Processing and Analysis & Preparation of Report

Dr. Adelina Barrera

Dr. Margarita Pérez

Mr. Lester Gómez Yllescas

Ms. Mariana Sequeira

Ms. Rosa Campos

Funding Agencies

United States Agency for International Development (USAID)

USAID Micronutrient Program (MOST)

Program for Modernization of the Health Sector (PMSS)

United Nations Children's Fund (UNICEF), Nicaragua

Micronutrient Initiative (MI), Canada

PROSIM Project, German Technical Cooperation (GTZ)

Field Supervisors

Ms. Mirna Zelaya

Ms. Ligia Teresa Yllescas

Ms. Ligia Soledad Saavedra

Mr. Mario Lacayo Noguera

Dr. Leonardo Juárez

Ms. Socorro Talavera

Ms. Ana Francisca Huete

Ms. Doris Mercado López

Interviewers

Ms. Carolina Marin

Ms. Edelma Dávila

Ms. Gioconda Obando

Ms. Hilda Sandino

Ms. Reyna Vilchez

Dr. Walkiria Palacios

Ms. Zayra Henriquez

Venopuncturists

Ms. Adina Ibarra

Mr. Juan Ramon Castillo

Mr. Manuel Centeno

Ms. Ana Luisa Jiménez

Ms. Mercedes Rodríguez

Ethics Committee

Dr. María Amparo Quintanilla, DAIMNA-MOH

Dr. Conrado Abarca, Director, Medical Inputs, MOH

Dr. Enrique Alvarado, Director, 1st Level of Care, MOH

Administrative Personnel

Ms. Fatima Calderón Sarria

Ms. Juana Moreno Almendárez

Ms. Marina Isabel Medina

Mr. Juan Carlos Hernández

Mr. Carlos Manzanares

Drivers

Mr. Carlos Hurtado Espinoza

Mr. Jorge Luis Martínez Tórrez

Mr. Enrique José Meléndez Bermúdez

Mr. Adolfo López Martínez

Mr. Oscar Danilo Largaespada

Mr. Reynaldo José Ruíz Matús

Mr. Róger Salazar Montenegro

Mr. Antonio Castillo Hernández

Table of Contents

Acronyms

AAGP	Alpha 1 Acid Glycoprotein
ARI	Acute Respiratory Infection
CDC	Centers for Disease Control
CNM	National Micronutrient Commission
CONASAN	National Nutrition and Food Security Commission
DHS	Demographic Health Survey
DHS-93	Demographic and Health Survey 1993
GTZ	German Technical Cooperation
Hb	Hemoglobin
IEC	Information, Education and Communication
INCAP	Nutrition Institute of Central America and Panama
INEC	Nicaragua Institute of Statistics and the Census
JNS	National Health Campaigns
LSMS98	National Living Standards Measurement Survey 1998
MI	Micronutrient Initiative
MOH	Ministry of Health
MOST	Micronutrient Operational Strategies and Technologies (USAID Project)
NDRC	National Diagnosis and Reference Center (MOH Central Laboratory)
NMC	National Micronutrient Commission
NMS-93	National Micronutrient Survey 1993
NMS-00	National Micronutrient Survey 2000
OMNI	Opportunities for Micronutrient Interventions (USAID Project)
PAHO	Pan American Health Organization
PMSS	Program for Modernization of the Health Sector
PNM	National Micronutrient Plan
SAS	Secretariat for Social Action
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VAD	Vitamin A Deficiency

The Government of Nicaragua has paid special attention to micronutrient deficiencies, particularly those of vitamin A, iron, and iodine, since the 1993 National Micronutrient Survey. This summary report of the subsequent 2000 survey provides information about the evolution of these deficiencies, which are considered to be significant public health problems in Nicaragua.

Introduction

The Government of Nicaragua (GON) has paid special attention to micronutrient deficiencies, particularly those of vitamin A, iron, and iodine, since the 1993 National Micronutrient Survey (ENM-93). This focus is due to the high percentage of the population affected by these deficiencies and their consequences on the health, well-being and survival of children and mothers, on child development and learning capacity, as well as on adult job performance and productivity. There is now a series of GON policies and programs directed at the prevention and control of these deficiencies, and the Nicaraguan government and the private sector have made a commitment to work together on these programs.

In 1994, the National Micronutrient Commission (NMC), responsible for formulating and coordinating the implementation of a five-year national plan (1996-2000) for the prevention and control of these deficiencies, was created. That same year, the Ministry of Health (MOH), concerned about the severity of sub-clinical vitamin A deficiency and anemia, decided to implement the distribution of vitamin A supplements to children under 10 years old as a temporary emergency measure to increase the levels of vitamin A in the population and to provide iron supplements to pregnant women and children to prevent anemia.

Since that time, a number of programs have been aimed at the prevention and control of micronutrient deficiencies.

- Supplementation with vitamin A has been part of the country's National Health Campaigns (JNS), which are conducted regularly twice a year with relatively high coverage.
- Additionally, the National Micronutrient Plan (NMP, 1996) includes food fortification as an effective medium-term measure for the sustainable control of micronutrient deficiencies. Through a formal agreement between the government and the flour industry, fortification of wheat flour with iron and B-complex vitamins was begun in 1997. Fortification of sugar with vitamin A was launched with the sugar harvest of 1999-2000, as a result of an historic agreement between the public and private sectors.
- There has been ongoing distribution of iron and folic acid supplements to pregnant women and children under five years old through regular health services, although the coverage and quality of the program have not been properly assessed.
- An Information, Education and Communications (IEC) plan, developed as part of the NMP, has been implemented to increase the demand for vitamin A and iron supplements and to promote positive changes in dietary habits to increase the consumption and biological utilization of foods that are rich in micronutrients.

In 2000, the GON, through the MOH, decided to conduct a second National Micronutrient Survey (NMS-00) to allow evaluation of the tendencies and changes in the micronutrient status of the population compared to the 1993 survey and also offer relevant information for the revision of the respective policies and programs in order to optimize their impact on the population. A factor of particular importance in this decision was the need for an adequate baseline on vitamin A deficiency in order to allow future evaluation of the impact of the program to fortify sugar with vitamin A. At the same time, it was recognized that information from the second survey would allow identification of the possible effects of the twice-yearly supplementation for children with massive doses of vitamin A, which began in 1994; measurement of the trends of nutritional anemia after three years of wheat flour fortification; estimation of the true coverage of micronutrient supplementation; and evaluation of the potential of other vehicles for iron and vitamin A fortification. Finally, it was judged extremely important to update the information on iodine and fluoride deficiencies.

Objectives

General

Determine the evolution of vitamin A deficiency and of anemia in children 6-59 months of age and mothers and caregivers, as well as the situation of iodine and fluoride in children from 6 to 9 years old.

Specific

1) Evaluate the nutritional status regarding vitamin A and the prevalence of anemia in children from 6 to 59 months of age and in mothers and caregivers of these children, and their associated factors.
2) Estimate the coverage of iron and vitamin A supplementation for children and mothers/caregivers.
3) Assess the pattern for purchasing foods fortified with iron and vitamin A, as well as some foods with potential for fortification with those micronutrients.
4) Assess the nutritional status regarding iodine and fluoride in children from six to nine years old.
5) Estimate the levels of iodine in salt and of vitamin A in sugar that are consumed in homes.

Methodology

Universe and Study Sample

The 2000 National Micronutrient Survey universe for study was composed of all women over 15 years old who were mothers/caregivers of children, as well as children from 6 to 59 months old in the country of Nicaragua. The sample used was probabilistic, multiphase, stratified and with variable sampling fractions. It was obtained by random selection of 227 of the 601 primary sampling units (PSUs) or conglomerates (census segments) used for the Nicaraguan Demographic and Health Survey of 1998 (DHS-98).

The size of the sample required in each of the strata to estimate an expected prevalence of 30% vitamin A deficiency or anemia (under the assumption that the rates found in the NMS-93 remained unchanged), was theoretically calculated at 336 mothers/caregivers and 336 children between 6 and 59 months, or a total of 2352 mothers/caregivers and 2352 children. Estimates were possible with 20% accuracy (acceptable error) and 95% confidence interval, with a design effect (of conglomerates) of 1.5 in view of the great homogeneity by region in the anemia and vitamin A deficiency rates in the NMS-93. Being a random sub-sample of DHS-98, the NMS-00 sample is nationally representative and was designed to obtain information from seven strata or geographic regions of the country (Table 1). The selection of the sample of eligible households was conducted by the Nicaraguan Institute for Statistics and the Census (INEC), using the DHS 98 database. The country's geographical or regional strata were composed in the following manner:

Table 1. Composition of the Geographical or Regional Strata

Region	Departments
1	Pacific Urban: Leon, Chinandega, Masaya, Granada, Carazo, Rivas
2	Pacific Rural: Leon, Chinandega, Masaya, Granada, Carazo, Rivas
3	Managua Urban
4	Central Urban: Boaco, Chontales, Jinotega, Matagalpa, Esteli, Nueva Segovia, Madriz
5	Central Rural: Boaco, Chontales, Jinotega, Matagalpa, Esteli, Nueva Segovia, Madriz
6	Atlantic Urban: North Atlantic, South Atlantic, Rio San Juan
7	Atlantic Rural: North Atlantic, South Atlantic, Rio San Juan

As Table 2 illustrates, the final sample selected comprised 2537 eligible households, and the same number of mothers/caregivers and children between 6 and 59 months of age. The breakdown by region for the planned and the implemented sample is also shown in Table 2.

The sample for the NMS-00 is comparable at the national level with the NMS-93, which used a sub-sample of the 115 census segments randomly selected from the nationally probabilistic sample of 230 census segments used in DHS-92/93. The sample from the NMS-93 was representative for three strata (Managua, other urban areas and rural areas). Therefore, comparisons with the NMS-00 are valid for common variables (plasma retinol, hemoglobin and socio-economic information) collected in 1993 and 2000, with the exception of the rural Atlantic region and the 6-11 months age group not included in NMS-93. The 2000 survey covered 225 census segments of the 227 that were planned, which represents 99.1% coverage. Two segments, located in the rural Atlantic region, were not covered due to geographical inaccessibility. Overall, coverage for the interview was 2,372 households, or 93.5% (Table 2).

Table 3 shows the coverage for the various types of biological and food samples, with the highest coverage for iodine in salt (97.3 percent), vitamin A in sugar (96.9 percent) and hemoglobin in children (90.9 percent).

Table 2. Coverage of the Survey Sample by Region

Region	Segments in DHS 98 Sample	Selected Segments EMN-2000	Covered Segments EMN-2000	Selected Households ENM-2000	Covered Households ENM-2000	Estimated Population 2000
1. Urban Pacific	117	40	40	466	457	799,499
2. Rural Pacific	92	34	34	385	364	774,317
3. Managua	77	25	25	321	300	1,262,660
4. Urban Central	86	34	34	364	335	545,583
5. Rural Central	137	52	52	561	522	1,035,818
6. Urban Atlantic	30	16	16	190	181	169,333
7. Rural Atlantic	62	26	24	250	213	484,461
Total for Managua and Urban Areas	310	115	115	1,341	1,273	2,777,075
Rural Area Total	291	112	110	1,196	1,099	2,294,596
National Total	601	227	225	2,537	2,372	5,071,671

Table 3. Coverage for Biological and Fortified Food Specimens

Type of Sample	Planned	Number of Samples Collected	Percentage
Hemoglobin in Mothers/Caregivers	2,537	2,232	88.0
Hemoglobin in Children	2,537	2,307	90.9
Retinol in Mothers/Caregivers	2,537	2,210	87.1
Retinol in Children	2,537	2,215	87.3
AAGP in Children	2,537	2,204	86.9
AAGP in Mothers/Caregivers	2,537	2,187	86.2
Urinary Iodine in Children	1,269	886	69.8
Urinary Fluoride in Children	1,269	756	59.6
Iodine in Household Salt	227	221	97.3
Vitamin A in Household Sugar	227	220	96.9

Organization of the Survey

The overall administration of the survey was the responsibility of the Director of Nutrition of the Ministry of Health, Dr. Antonio Largaespada. The director had the support of technical advisors from USAID (MOST Project), UNICEF, INCAP/PAHO and MI in the design and implementation of the NMS-00, as well as in the analysis and preparation of the report. Personnel with previous experience in household surveys, including taking and storing biological samples, were contracted for the fieldwork. Six field teams were formed and were supervised by personnel from the MOH Nutrition Department. Over the course of a week, the personnel received theoretical and practical training in the management of instruments for the data and sample collection and for identifying and approaching the pre-selected households. A pilot test was conducted in a census segment that was not included in those selected for the NMS-00 sample.

The data collection fieldwork took place from January 20 to March 29, 2000. The quality of information was assured through training and close supervision at the time of data collection in the households and, later, in the office-based work. The protocol for the NMS-00 was reviewed at the appropriate time by an ad hoc Ethics Committee convened by the Ministry of Health. All measures necessary to protect the rights of participants in the survey were taken, in compliance with the Committee's recommendations and international guidelines. The subjects of this research (mothers/caregiver and children) were adequately informed about the objectives, methods, benefits and potential risks of the survey as well as the discomforts implied. All necessary precautions were taken to respect the privacy of the subjects and to protect their physical, moral and emotional integrity.

Data Collection Methods

Household Interviews

Cartography that was updated by the National Institute of Statistics and Census (INEC) for DHS-98 was used for the fieldwork. Data collection was conducted through visits to pre-selected households with children within the specified age rage, during which an interview of the mother/caregiver of the child was conducted using a previously validated questionnaire. The questionnaire contained the following sections: General Data and Household Characteristics, Maternal Supplementation, Morbidity and Supplementation for the Child Under Five Years Old, Pattern of Purchase and Consumption of selected foods. The questionnaire was accompanied by a form for recording the data on the samples taken for laboratory analysis (biological and food samples).

Biological Samples

Venous blood samples were taken from the cubital or radial vein of both the children selected and their mothers/caregivers. The samples were transported to a regional laboratory where the blood was centrifuged daily and the plasma was transferred to labeled cryovials that were covered with aluminum foil. The tubes were transported in refrigerated coolers and stored in a freezer at -20° Centigrade in the central laboratory of the MOH's National Diagnosis and Reference Center (NDRC). Later, the cryovials were packed in dry ice at -20° Centigrade and transported by air to the INCAP laboratories in Guatemala, to be analyzed for serum or plasma retinol using the conventional HPLC method and for AAGP using turbidimetry (INCAP, 1998).

For measurement of hemoglobin in the venous blood samples of children and mothers/caregivers a drop of blood was transferred from the tube to a special microcuvette for the portable, digital-readout hemoglobin analyzer (HemoCue) at the site of sample collection. The results of the hemoglobin measurement for the mother/caregiver and for the child were immediately provided in writing and explained to the mother and head of household.

An on the spot urine sample (approximately 50 ml.) was taken from children from 6 to 9 years old, using procedures established by INCAP. A 10 ml aliquot was taken from this sample on a specific monovette and used to analyze urinary iodine at INCAP laboratories. The remainder of the urine was deposited in a bottle containing EDTA for analysis of urinary fluoride at the MOH/NDRC.

A salt sample of approximately 15 grams was obtained from each household in each segment (one tablespoon per household); all of the samples from the same segment were combined in a composite sample of approximately 165 grams, in compliance with procedures for obtaining composite samples established by the MOH's CNDR in Managua. The iodine content of each composite sample of salt was analyzed using the conventional method. As with the salt samples, composite samples were also taken for sugar (one 15-gram tablespoon per household) of approximately 165 grams of sugar per segment. These samples were sent to the MOH central laboratories for analysis of the vitamin A content using the conventional method.

Data Processing and Analysis

A program for data entry was designed in the Epi-Info Program Version 6.04. For data cleaning, the EPI-INFO standard procedures were used. As the collection and data entry of the information from each of the seven geographical regions was completed, partial results became available with the production of descriptive tables with the frequency distribution of the questionnaire data, including information on hemoglobin. The serum retinol results, AAGP and urinary iodine were recorded in the data base as they were officially issued by INCAP. For the data analysis, the SPSS statistical program was used to produce descriptive tabulations of each variable. The mean and the standard deviation were calculated for continuous variables, for the regions and for the entire sample. The individual hemoglobin data were adjusted for altitude by the CDC recommended method, using the altitude value (meters above sea level) for each segment.

A "socio-economic level" variable was generated using the same criteria as in NMS-93, based on the number of household appliances, furnishings and some basic services: piped-in water, toilet, number of bedrooms, electricity, radio, television, refrigerator, own vehicle and gas or electric stove. Each of these was assigned one point and the following categories were established: low (less than 4 points), middle (4-6 points), high (7-9 points).

For the analysis of apparent consumption of selected foods in the household the week prior to the survey, a new variable was created in the data base "average consumption per person", which is the result of the amount of food purchased (estimated in grams) divided by the number of people who live in the household and by the family's usual interval of time in days between purchases of the food.

Weighing factors for key variables were calculated using the reciprocal of the final probability of selection of each household, mother/caregiver or child, defined as the product of the resulting probabilities at each stage of the selection and measurement processes, in order to expand from sample values to the survey universe (total households and population of mothers/caregivers in the country) and to calculate national weighted rates. Each set of final weights for the households (interview data) has two basic components: the inverse value of the fraction of the sample, calculated as a function of the urban or the rural population of each department, and the inverse value of the coverage rate for complete interviews in the pre-selected households. The product of these two components results in a gross weight for the households interviewed in which the contribution of the first component is greater. The final weights for the individual data for the mothers/caregivers and the children (serum retinol, hemoglobin, AAGP) represent the product of the gross final weight of the households and the inverse of the individual response rate, that is, of the individual coverage for each measurement. The weighting factors were entered into the SPSS program and used to estimate rates and percentages. In addition, the SAS program was used to calculate the sampling errors and confidence intervals.

Table 4. Criteria and cut-off points for analysis of biological and food specimens

Estimated Measurement	Criteria	
Anemia in Non-Pregnant Mothers/Caregivers	Hemoglobin	<12 g/dl
Anemia in Pregnant Mothers/Caregivers	Hemoglobin	<11 g/dl
Anemia in Children 6-59 Months	Hemoglobin	<11 g/dl
Vitamin A Deficiency in Children	Serum or Plasma Retinol	<20 μg/dl
Vitamin A Deficiency in Mothers/Caregivers	Serum or Plasma Retinol	<30 μg/dl
Iodine Deficiency in Children 6-9 years	Urinary Iodine	<10 μg/dl
Iodine Level in Salt	Iodine in Salt	
	Deficient	<15 ppm
	Low	15 - 30 ppm
	Acceptable	>30 ppm
Vitamin A Level in Sugar	Vitamin A In Sugar	
	Deficient	<5 ug/g
	Acceptable	5 - 9 ug/g
	Desired	10 - 14 ug/g
	High	≥15 ug/g
Urinary Fluoride Level	Urinary Fluoride	
	Very Low	<0.4 μg/ml
	Low	0.4 - 0.7 μg/ml
	Normal	0.8 - 1.1 μg/ml
	High	1.2 - 1.6 μg/ml
	Very High	≥1.61 μg/ml
Infection/Inflammation Marker	AAGP	>1.0 g/l

The averages and the standard deviations of continuous variables were calculated as well as the median levels of urinary iodine by region and nationally. Estimates for prevalence and coverage rates of supplementation were made. Based on simple frequency distributions, relevant variables were selected to conduct analysis of the association between them through cross-distribution of two or more variables (means and standard deviations).

Table 4 summarizes the various criteria (cutoff points) used for estimating the prevalence of anemia, VAD, iodine and fluoride deficiencies, and for categorizing levels of vitamin A in sugar and iodine in salt.

For purposes of comparison with the results of NMS-93, data from NMS-00 was grouped in three strata: Managua, other urban areas and rural areas. The rural Atlantic region and all children 6-11 months in the entire country were excluded as NMS-93 did not cover that region nor included children 6-11 months. For both NMS-93 and NMS-00 the anemia and VAD rates in children were standardized by age.

Results

Description of Households

This section describes the sample used by the National Micronutrient Survey (2000), in terms of socio-demographic structure, housing characteristics, accessibility to basic services, and socio-economic level. The results of this survey are not strictly comparable to those of DHS-98 as, despite using a sub-sample of the households covered by that survey, the families were pre-selected based on the presence of at least one child under four years old or one pregnant woman in the household in 1998. Some findings of DHS-98 and of the Living Standards Measurement Survey (LSMS) conducted in 1998 are also mentioned in this report as a point of reference to interpret the findings of the NMS-00.

Of the 2,372 households selected and included in the ENM 2000, 59.1% were located in urban areas. The maximum number of household inhabitants was twenty-one, with an average of 6.8 per house, a standard deviation of 2.9 and a mean of six. A high percentage of homes housed nine or more people (23.2%). Slightly more than half (56.6%) of the mothers/caregivers reported only one child under five years old living in their household, while in nearly a third (32.3%) there were two children of this age group. Some 77.0% of the mothers/caregivers interviewed indicated that the head of their household was a man.

More than half of the houses had a dirt floor (52.1%). The majority of the households had only one room (53.4%) and 29.4% had two rooms. The LSMS 98 defined overcrowding as three or more people sleeping in one room. A majority (79.7%) of the households was overcrowded, according to this definition. About 71% of the households use firewood for cooking and 26.1% use butane gas. The majority of the families used a latrine (73.2%), while 11.4% have neither toilet nor latrine and relieve themselves in the open air. Half (50.1%) of the households indicated that they incinerate their garbage, and above one fourth took advantage of a garbage collection service (26.6%).

Less than half of the households (44.1%) had potable water pipes in the yard and 15.8% have indoor plumbing. More than two-thirds (71.3%) of them had electricity. The most common appliance owned was the radio, mentioned by 77.0% of those interviewed. The next most frequently owned appliance was the television, present in more than half of the households (55.7%). Some 16.1% of the households had refrigerators and a small percentage (5.6%) owned a vehicle.

Slightly more than half of the Nicaraguan families included in the study fell within the low socio-economic level (52.5%), more than a third (39.8%) were classified as middle level and the smallest percentage (7.7%) were categorized as high level (Table 5). The regions with the highest percentage of households in the high level category (17.3%) were Managua and the urban Central region (11.1%). No household in the rural Atlantic region was classified as falling into the high socio-economic level. In general, the majority of households fell between the low and middle socio-economic categories, with the rural Atlantic and rural Central regions having higher percentages of households in the low level (97.5% and 91.2% respectively).

Table 5. Socio-Economic Level of the Households (n = 2,372)						
Region	**Low Level**		**Middle Level**		**High Level**	
	Number	Percentage	Number	Percentage	Number	Percentage
1. Urban Pacific	128	27.8	284	62.8	45	9.4
2. Rural Pacific	271	75.9	91	23.8	2	0.3
3. Managua	52	17.3	196	65.4	52	17.3
4. Urban Central	130	38.7	167	50.2	38	11.1
5. Rural Central	479	91.2	40	8.1	3	0.7
6. Urban Atlantic	114	63.2	60	33.0	7	3.8
7. Rural Atlantic	202	97.5	11	2.5	-	-
Urban Total	424	28.2	707	59.2	142	12.6
Rural Total	952	87.7	142	12.0	5	0.4
Total	1376	52.5*	849	39.8*	147	7.7*

* Weighted percentage

Table 6. Characteristics of Mothers/Caregivers Interviewed (n = 2372)		
Characteristics	**Number**	**Percentage***
Age of the Mothers/Caregivers (in years)		
15 – 19	294	12.5
20 – 24	634	26.2
25 – 29	543	23.2
30 – 34	345	14.5
35 – 39	245	10.9
40 – 44	141	5.9
45 and older	170	6.6
Can Read	1906	81.2
Schooling		
None	519	21.0
One to Three Years of Primary	450	18.4
Four to Six Years of Primary	707	29.3
One to Five Years of Secondary	605	27.4
High Education or Technical Studies	91	3.9
Work Situation		
Compensated Work	449	18.8
Pregnant During 1999 to Date	554	24.4
Currently Pregnant	151	6.4

* weighted percentage

Characteristics of Mothers/ Caregivers and Children

The average age of mothers/caregivers was 28.9 years, with a standard deviation of 9.6 and a mean of 27 years (Table 6). Some 24.4% of the mothers/caregivers reported having been pregnant during the period from January 1999 to the date of the interview, although only 6.4% were pregnant at the time of the interview. Of the mothers/caregivers, 18.8% stated that they cannot read; 21.0% had not attended school and 47.7% had attended primary school. The average number of years of schooling was 5.9 with a standard deviation of 3.3 years and a median of 6 years. The majority of the women (81.2%) did not work outside the home.

The average age of the children who participated in the ENM 2000 was 29.4 months, with a standard deviation of 11.6 and a median of 28 months (Table 7). About twenty-five percent of the children between 6 and 59 months had presented some episode of diarrhea in the two weeks prior to the survey. The smallest percentage was in the rural Pacific region (17.0%), while the urban and rural Atlantic region had the largest percentages (34.3% and 32.8%, respectively).

Table 7. Characteristics of the Children (n = 2372)

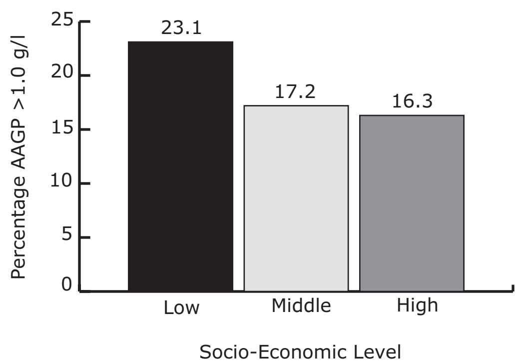
Characteristics of the Children	Number	Percentage*
Age (in months)		
6 – 11	281	12.2
12 – 23	665	29.0
24 – 35	616	25.0
36 – 47	459	18.9
48 – 59	351	14.9
Sex		
Female	1159	48.8
Male	1192	51.2
Morbidity		
Diarrhea	601	25.5
Cough	1505	63.9
Cough & Fatigue/Difficulty in Breathing	440	18.5
AAGP > 1.0 g/l	490	20.3

· weighted percentage

More than half (63.9%) of the children between the ages of 6 and 59 months had some cough in the two weeks prior to the visit. Almost one fifth (18.5%) of the children presented a cough and fatigue or difficulty in breathing. Some 20.3% of the children studied had, at the time of the survey, some active infectious and/or inflammatory process (AAGP > 1.0 g/l).

The children from the rural areas had a higher percentage (24.0%) of AAGP values greater than 1.0 g/l compared to those in the urban areas (17.6%). The highest percentage of children with AAGP values greater than 1.0 g/l was found among children from households in the low socio-economic level

Figure 1. Children from 6 to 59 Months with AAGP > 1.0 g/l By Socio-Economic Level



(23.1%). In children from the middle socio-economic level, the percentage decreased to 17.2% and the lowest percentage (16.3%) was found at the highest socio-economic level. The differences in percentages are statistically significant ($p = 0.001$). The percentage of children with high AAGP levels decreased consistently as age increased.

The proportion of high values for AAGP was significantly greater (26.0%) in the group of children with a history of diarrhea in the two weeks prior to the survey compared with those that had not had diarrhea (18.5%). Overall, 31.0% of children that had had some cough and difficulty breathing in the two weeks prior to the survey had AAGP concentrations above 1.0 g/l, compared to 18.0% for those that did not suffer such symptoms. The differences are statistically significant ($p = 0.000$).

Food Purchasing Pattern

Vegetable oil. The Ministry of Health has considered the possibility of fortifying vegetable oil with vitamin A; thus it is important to know the extent of consumption. In about 96% of the households had used some type of fat to prepare food during the week prior to the survey, 92% used vegetable oil, 6.5% used vegetable fat, 1.3% animal lard and 0.2% used margarine. The average per capita consumption of vegetable oil was estimated at 34.4 ml per day, with a standard deviation of 26.9 ml and a median of 26.6-ml (Table 8). Approximately half (43.7%) of the mothers/caregivers stated that they began to offer foods prepared with oil to their children between six and eight months of age, while 29.3% did it between three and five months of age. The average age for beginning this practice was 6.6 months, with no substantial differences by region. The majority of mothers/caregivers (93.3%) generally used oil for the preparation of fried food and only 0.1% added it to salads. Some 6.6% of mothers/caregivers indicated that they did not use oil.

Sugar. Beginning with the sugar harvest that started in November of 1999, all sugar for household consumption that is produced in the country was expected to be fortified with vitamin A. Almost all households (99.3%) stated that they used sugar to sweeten their food, with sulfated sugar used most frequently (69.7%); close to one third (29.0%) use white sugar and only 1.3% consume brown sugar (Table 8). The consumption of some type of sugar in the households during the week prior to the survey was practically universal (99.3%). The average per capita consumption of sugar was estimated at 64.7 g per day, with a standard deviation of 43.7 g and a median of 56.7-g (including brown sugar, which is not fortified).

Bread and Pasta. Since 1997, the wheat flour produced in Nicaragua has been fortified with iron and B-complex vitamins. In other words, bread and other foods with a wheat flour base are fortified. Some 86.5% of those interviewed stated that they had consumed bread or sweet bread (one of the two or both products) during the week prior to the survey (Table 8). The per capita consumption per day was 22.3 g, with a standard deviation of 41.7 g and a median of 8.9 g. The reported consumption of all kinds of bread was higher in urban areas (93.5%) than in rural areas (76.3%).

Table 8. Food Consumption by Family the Previous Week (n = 2372)

Foods Consumed	No.	Percentage*	Per Capita Consumption (g/day)
Fats	2247	95.5	31.7 ± 27.4
Vegetable Oil	2154	92.0	
Vegetable Fat	179	6.5	
Sugar	2354	99.3	64.7 ± 43.7
Bread or Sweet Bread	2034	86.5	22.3 ± 41.7
Rural	1084	76.3	
Urban	1288	93.5	
Salt	**2370**	**99.9**	
Coarse	2256	94.3	
Refined	114	5.6	
Tortilla	2000	84.5	89.2 ± 99.8
Purchased	901	50.6	
From Whole Corn	746	79.5	
From Maseca (corn flour)	120	16.7	
Homemade	1099	49.4	
From Whole Corn	940	86.2	
From Maseca (corn flour)	57	5.3	

*Weighted percentage and average

Salt. Practically the entire population consumed salt regularly (99.9%). Of the families interviewed, 94.3% usually consumed coarse salt (Table 8).

Tortillas. Tortillas were consumed in 84.5% of the households the week prior to the interview. The per capita tortilla consumption was 89.2 g per day, with a standard deviation of 99.8 and a median of 60 g. Greater numbers consume tortillas prepared from whole corn, whether purchased or homemade (79.5% and 86.2% respectively). Tortillas prepared from Maseca (commercial corn flour) are less frequent (16.7% for purchased tortillas and 5.3% for homemade). Other brands of corn flour tortillas were mentioned by less than 3% of the women.

Supplementation with Vitamin A and Iron

Vitamin A. Only 11.5% of the mothers/caregivers reported having received vitamin A supplements immediately following their last delivery. The supplement was delivered in the hospital or the health center. Coverage of children with vitamin A supplementation was 54.5% in the previous six months (Table 9). Of these, 64.9% (885 cases) could be verified with the immunization card. The immunization cards confirmed that approximately half of the 885 children had received these supplements four months prior to the date of the survey, 30.6% three months prior and only 7.4% less than three months prior. The most recent Health Campaign had occurred in October 1999 or three to five months prior to the survey. Almost all of the mothers/caregivers (97.6%) stated that the vitamin A supplements were offered to their children by the Ministry of Health medical services, through the National Health Campaigns.

Table 9. Vitamin A Supplementation of Children 6-59 Months in the Last Six Months

Supplementation Characteristics	Number	Percentage*
Vitamin A Supplementation in Children (n = 2372)		
Documentation on Immunization Card	885	33.5
Stated by the Mother	479	21.0
Total Documented or Stated by the Mother	1364	54.5
Did Not Receive	1008	45.5
Date Received Vitamin A According to Immunization Card (n = 885)		
0 – 2 Months	66	7.4
3 Months	271	30.6
Four Months	405	45.8
Five Months	92	10.4
Six Months	51	5.8

* Weighted percentage

Iron. Some 69.5% of the mothers/caregivers interviewed that had been pregnant during the period from 1999 to the date of the interview or that were currently pregnant reported having received iron supplements during that latest pregnancy. The largest percentage of mothers/caregivers who had received iron supplements was in the urban Pacific region (74.1%), followed by Managua and the rural Central region (71.1% and 70.7% respectively). The region with the lowest percentage of mothers/caregivers that received iron supplements was the rural Atlantic region (57.3%). The majority of the mothers/caregivers that received iron supplements indicated that they obtained them in the Health Center (85.1%). More than half of the children (58.3%) received iron supplements at some point. Thirty-seven percent received them in the preceding six months, mostly supplied by the Health Center or Health Post (81.7%). Another 8.8% reported having purchased them, 3.5% obtained them from private services and 3.9% mentioned the National Health Campaign.

Vitamin A deficiency in Mothers/ Caregivers

The average serum retinol level for mothers/caregivers was 45.5 µg/dl, with a standard deviation of 13.7 µg/dl and a median of 43.8 µg/dl.

The weighted national prevalence of vitamin A deficiency (VAD) in mothers/ caregivers (serum retinol <30 ug/dl) was 10.9% (Table 10). Managua had a highest prevalence (21.6%). Differences by age were not found. VAD similarly affected mothers/ caregivers of all ages. The VAD percentages were similar for mothers/caregivers who knew how to read and those that were illiterate. The proportion of mothers/caregivers with vitamin A deficiency was similar among those at the low socio-economic level (10.6%) and those at the high level (10.3%). The mothers/caregivers who had not received iron supplements during their last pregnancy had a higher incidence of VAD (11.5%) than those that had received supplements (8.3%). VAD

Table 10. Distribution of Serum Retinol Values for Mothers/ Caregivers of Children 6-59 Months

Serum Retinol Values (µg/dl)	Number	Percentage*	Cumulative Percentage
< 10	2	0.1	0.1
10 – 19	29	1.3	1.4
20 – 29	212	9.5	10.9
30 – 39	592	26.7	37.6
40 – 49	663	29.9	67.5
50 – 59	388	17.5	85.0
60 – 69	221	10.0	95.0
70 – 79	79	3.6	98.6
80 – 89	29	1.3	99.7
90 - 99	6	0.3	100
Total	**2221**	**100**	

* Weighted percentage

Table 11. Prevalence of VAD (Retinol < 30 µg/dl) in Mothers/Caregivers of Children 6-59 Months by Whether They or Their Children Had Anemia, VAD and High AAGP

	Number	VAD in Mothers/ Caregivers Percentage*	Total
Anemia in Mothers/Caregivers			
Yes	66	18.5**	461
No	109	8.3	1593
Anemia in Children			
Yes	77	11.6	786
No	120	10.4	1370
Vitamin A Deficiency in Children			
Yes	33	19.9**	186
No	150	9.4	1887
Mothers/Caregivers with AAGP >1.0 g/l			
Yes	21	15.0	150
No	177	10.5	2027

* weighted percentage
** ($p < 0.05$)

Table 12. Distribution of Serum Retinol Values in Children 6-59 Months

Serum Retinol Values (µg/dl)	Number	Percentage*	Cumulative Percentage
5 – 9	5	0.2	0.2
10 – 14	44	1.9	2.1
15 – 19	160	6.7	8.8
20 – 24	424	17.8	26.6
25 – 29	531	22.3	48.9
30 – 34	497	20.9	69.7
35 – 39	340	14.3	84.0
40 – 49	259	10.9	94.9
50 – 59	76	3.2	98.1
60 or more	45	1.9	100.0
Total	**2381**	**100**	

* weighted percentage

prevalence for those that work and those that do not work was similar. Only 1.4% of the women had serum retinol levels <20 ug/dL.

A statistically significant relationship was found between anemia and VAD in mothers/ caregivers (Table 11). Of the mothers/ caregivers who were anemic, 18.5% were deficient in vitamin A, while the percentage was lower for non-anemic mothers/caregivers (8.3%). Another statistically significant relationship was found between VAD in the children and VAD in their mothers/caregivers, with double the percentage of vitamin A deficient mothers/caregivers when the children were also VAD than when they were not VAD (19.9% vs. 9.4%). About 15% of the women with high AAGP had deficient levels of serum retinol, compared to 10% of those with normal AAGP.

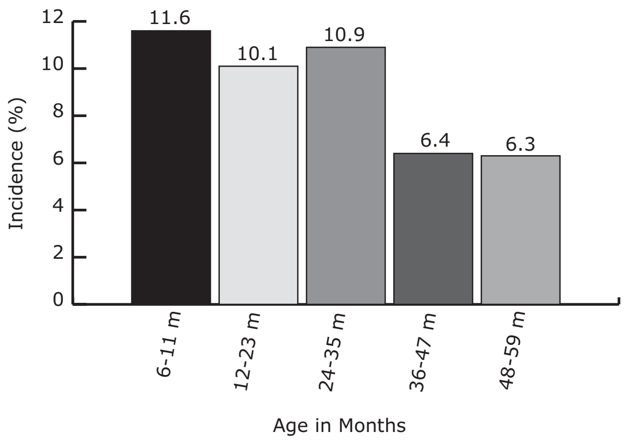
Vitamin A Deficiency in Children 6-59 Months

The national average for serum retinol in children was 31.5 µg/dl, with a standard deviation of 10.2 µg/dl and a median of 30.2 µg/dl.

The total weighted prevalence of VAD (serum retinol < 20 µg/dl) in children between 6 and 59 months was 8.8% (Table 12). Only five children (0.2%) presented retinol levels less than 10 µg/dl, an indicator of severe VAD. The region with the highest percentage of VAD was Managua (11.4%), followed by the rural Central region (10.0%). The prevalence of VAD was similar in the urban regions and the rural regions (8.9%). The percentage of children with vitamin A deficiency tended to decrease as age increased (Figure 2). The highest prevalence occurred in the 6 to 11 month's age group (11.6%), while the lowest was found in the 48 to 59 month's age group (6.3%). Boys had a higher prevalence of VAD (9.6%) than girls (8.0%) did.

No relationship was found between the women's level of schooling and the VAD prevalence in their children. Likewise, the prevalence of VAD in children whose mothers/caregivers work did not differ from that of the children whose mothers/caregivers do not work outside the home. No statistically significant relationship was found between the prevalence of VAD in children and the socio-economic level of their families.

Figure 2. Prevalence of Vitamin A Deficiency (Retinol < 20 μg/dl) in Children By Age



Some 10.6% of the children who had had diarrhea in the two weeks prior to the date of the survey were deficient in vitamin A, while the percentage for the groups that had not had diarrhea was 8.2%. The prevalence of VAD was similar for the group of children that presented cough and difficulty breathing in the two weeks prior (7.9%) and for the group without these symptoms (9.0%). In children with AAGP >1.0 g/l, the prevalence of VAD was 2.7 times greater (17.6%) than in those children with AAGP levels <1.0 g/l (6.7%). The difference is statistically significant ($p = 0.000$).

The prevalence of VAD was only 3.2% in the 63 children that showed documentation that they had received vitamin A supplements less than three months before the survey, compared with 6.0% for those 234 children who received supplements three months before, 9.8% for hose 376 children who received vitamin A four months before, and 9.2% for those 65 children that received the micronutrient five months earlier. The prevalence of VAD was slightly lower in those children that had received iron supplements in the six months prior to the survey (7.6%) compared with those that did not receive iron (9.0%).

In the group of children whose mothers/caregivers were anemic, 11.9% were deficient in vitamin A, while among those children whose mothers/caregivers were not anemic, 8.1% were deficient ($p = 0.010$). Likewise, the prevalence of vitamin A deficiency among anemic children was significantly higher (13.4%) than among those that were not anemic (6.5%) ($p = 0.000$). No relationship was found between the deficiency of vitamin A in children and the consumption of sugar by the family in the week prior to the survey. This was to be expected as virtually all of the households consumed sugar in the week prior (sees the section on consumption) and, in addition, fortified sugar was only beginning to reach the consumer.

Anemia in Mothers/Caregivers

Some 6.4% of the mothers/caregivers who participated in the survey were pregnant on the day of the survey. Of these, 32.9% presented anemia (cut-off point: hemoglobin < 11 g/dl), which is the weighted national

Table 13. Distribution of Hemoglobin Values in Non-Pregnant Mothers/Caregivers

Hemoglobin Values (g/dl)	Number	Percentage*	Cumulative Percentage
5.00	1	0.1	0.1
6.00	1	0.1	0.2
7.00	8	0.4	0.6
8.00	16	0.8	1.4
9.00	40	1.9	3.3
10.00	108	5.2	8.5
11.00	292	13.9	22.4
12.00	640	30.6	53.0
13.00	641	30.6	83.6
14.00	281	13.4	97.0
15.00	60	2.9	99.9
16.00	5	0.2	100
Total	**2093**	**100**	

*weighted percentage

rate of prevalence of anemia in pregnant women. In the mothers/caregivers who were not pregnant, mean hemoglobin was 12.7 g/dl, with a standard deviation of 1.36 g/dl and a median of 12.8 g/dl.

The weighted national prevalence of anemia in non-pregnant mothers/caregivers (hemoglobin < 12 g/dl) was 22.3% (Table 13). The regions with the highest rates of anemia were the urban Atlantic and the rural Atlantic (36.0% and 31.8% respectively). The percentage of anemia was slightly higher (23.8%) in the urban area than in the rural (20.0%) and for those that did not know how to read (22.8%) than those who were literate (22.2%). Of the mothers/caregivers who were pregnant during the year prior to the survey, 28.7% were anemic, while the percentage was lower (19.9%) for those mothers/caregivers who were not pregnant during that period. There was a clear relationship between having received iron supplements during their last pregnancy and the incidence of anemia in mothers/caregivers. Four out of every ten mothers/caregivers that did not receive supplements were anemic (41.1%), compared with 24.5% of those that received supplements. These finding should be interpreted cautiously, as this survey did not investigate when supplementation began, how long it lasted or adherence to the supplements.

The relationship between the prevalence of anemia and socio-economic level was not statistically significant, nor were statistically significant differences in anemia prevalence among mothers/caregivers whether or not bread was consumed in the household (21.8% and 25.1%). Some 31.7% of mothers/caregivers of anemic children were found to be anemic compared with only 17.1% of mothers/caregivers of non-anemic children.

Anemia in Children 6-59 Months

An average of 11.3 g/dl of hemoglobin was found for children from 6 to 59 months of age, with a standard deviation of 1.34 g/dl and a median of 11.5 g/dl.

Table 14. Distribution of Hemoglobin Values In Children 6-59 Months

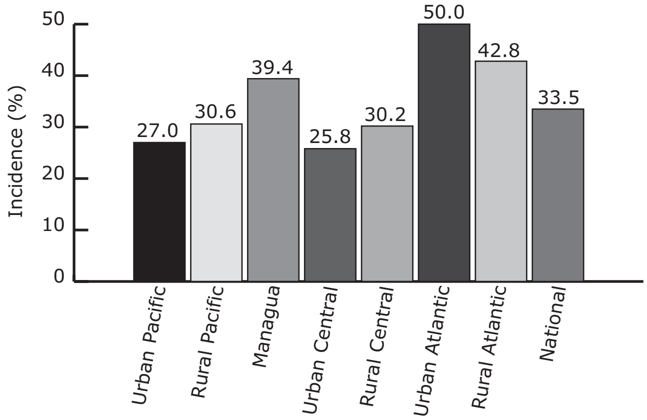
Hemoglobin Values (g/dl)	Number	Percentage*	Cumulative Percentage
5.00	7	0.3	0.3
6.00	14	0.6	0.9
7.00	27	1.1	2.0
8.00	72	3.0	5.0
9.00	195	8.2	13.2
10.00	482	20.2	33.4
11.00	766	32.2	65.6
12.00	610	25.6	91.2
13.00	189	7.9	99.1
14.00	16	0.7	99.8
15.00	2	0.1	99.9
16.00	1	0.1	100
Total	**2381**	**100**	

* weighted percentage

The national rate for anemia in children from 6 to 59 months, weighted and adjusted for age, was 33.4%, with a cut-off point of 11 g/dl (Table 14). The highest prevalence (50.0%) was observed in the urban Atlantic region, followed by the rural Atlantic region with 42.8% (Figure 3). The third highest rate was found in Managua where 39.4% of children were anemic. The overall rate for severe anemia (< 7 g/dl) was 0.8%. There were not differences in the percentages for anemia between residents of rural areas and those from urban areas (33.3% and 33.6% respectively).

The highest anemia rate was found in the 6 to 11 month old group (61.8%), followed by the 12 to 23 month old group (54.2%). The rate for anemia decreased as age increased (figure 4), with children from 48 to 59 months old having the lowest rate (11.6%). The relationship between age and prevalence of

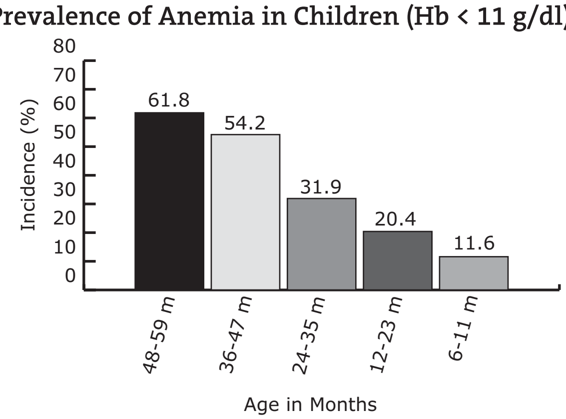
Figure 3. Prevalence of Anemia in Children 6-59 Months (Hb<11 g/dl) by Region



anemia was significant (p = 0.000). The prevalence of anemia in children who live in situations where a woman is the head of household is the same as in those that live where the head of household is a man (33.6%). No difference was found in the prevalence of anemia between boys and girls (34.3% and 32.2%).

Thirty-one percent of children whose mothers had gone to school for more than nine years were anemic compared with 35.9% of those whose mothers/caregivers had never gone to school. These differences in percentage are statistically significant (p = 0.017).

Figure 4. Prevalence of Anemia in Children (Hb < 11 g/dl) by Age



A higher prevalence of anemia was found in families with higher numbers of children less than five years. The percentages of anemia in the groups of children from the low and middle socio-economic levels were similar (35.2% and 34.2% respectively), while only 18.2% of the high socio-economic level group had anemia. These differences are statistically significant (p = 0.000). Nearly half (46%) of the children that had an episode of diarrhea in the two weeks prior to the survey were anemic compared with three of every ten (29.6%) of those that had not had diarrhea. The difference is statistically significant (p = 0.000). Of the children with anemia, 27.4% had AAGP concentrations of > 1.0 g/l, i.e. at the time of the survey they had some time of infectious process, whereas among non anemic children only 16.7% had AAGP > 1.0 g/l. The difference is statistically significant (p = 0.000).

Statistically significant differences (p = 0.000) were found in the anemia rate of children who received vitamin A supplements and those that did not receive them (28.8% vs. 40.3%). Of the children whose mothers/caregivers were anemic, 48.2% were also anemic, compared to 28.8% among children whose mothers/caregivers were not anemic. This relationship was statistically significant (p = 0.000). In the group of children who were vitamin A deficient, 50.5% were anemic while only 31.4% had anemia in the group without vitamin A deficiency. This was a statistically significant relationship (p = 0.000). No statistically significant association was shown between the consumption of sweet bread or bread and anemia in children.

The rate for severe anemia (hemoglobin < 7 g/dl) in children, adjusted for age, was below one percent (0.9%). The regions with the highest rates were the urban Atlantic region (2.0%) and Managua (1.9%). The rates for severe anemia were very low in the urban and rural Pacific regions (0.2% and 0.3% respectively) and in the rural Central region (0.4%). Severe anemia was most frequent

Table 15. Distribution by Age Groups of Mothers/Caregivers and Children in NMS-93 and NMS-00

Age Groups	1993		2000	
	No.	%	No.	%
Mothers/Caregivers (years)				
15 – 19	125	8.4	294	12.4
20 – 29	635	42.8	1177	49.6
30 – 39	599	40.4	590	24.9
40 >	123	8.3	311	13.1
Total	1482	100	2372	100
Children (months)				
6 – 11	-	-	281	11.8
12 – 23	456	25.8	665	28.0
24 – 35	468	26.5	616	26.0
36 – 47	473	26.8	459	19.4
48 – 59	370	20.9	351	14.8
Total	1767	100	2372	100

Figure 5. Comparison of the Distribution of Serum Retinol Level in Children

1993 – 2000

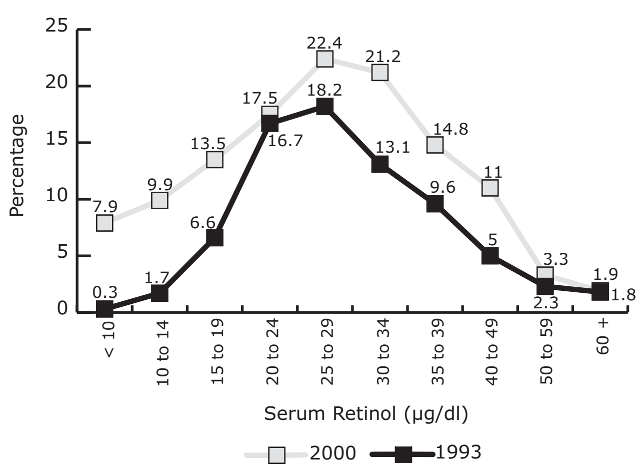
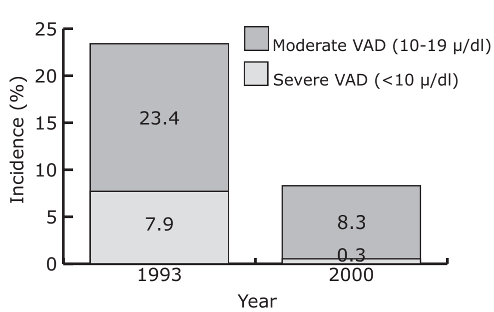


Figure 6. Prevalence of Vitamin A Deficiency in Children 12-59 Months, by Severity, 1993 – 2000



in infant's 6-11 months (1.8%), compared to 1.4% in children 12-23 months. Severe anemia was not detected in children 48-59 months. The prevalence of severe anemia was greater in the urban areas (1.1%) than in the rural (0.5%).

Changes from 1993 to 2000

In this section the results of NMS-00 are compared to those reported from NMS-93. The subjects and samples from the rural Atlantic region and from the 6 to 11 month old age group have been excluded for the purposes of this comparison, as they were not included in the 1993 survey. In addition, the 2000 data is grouped into three regions (Managua, other urban and rural areas) as in 1993. Rates were weighed and adjusted for age for the comparisons. Table 15 shows the distribution by age of children and mothers in the two surveys.

In the 2000 survey, almost half (48.1%) of the households were in the low socio-economic level, a higher percentage than the 42.6% reported in the 1993. The proportion of households categorized at the middle level was similar in the two surveys (41.7% in 1993 and 43.4% in 2000). In the 2000 survey, 8.5% of the households were classified at the high socio-economic level, a smaller percentage than that found in 1993 (15.7%). The data by strata or regions reflect a similar situation.

Vitamin A Deficiency in Children 12-59 Months

The distribution of serum retinol levels in children clearly moved to the right (toward higher values) from 1993 to 2000 (Figure 5). The percentage of children with normal retinol concentrations (above 20 µg/dl) was significantly higher in 2000 than in 1993 (Figure 6).

The prevalence of sub-clinical vitamin A deficiency (VAD), weighted and adjusted

Figure 7. Comparison of the Distribution of Hemoglobin Levels (g/dl) in Mothers and/or Caregivers of Children 12-59 Months, 1993 – 2000

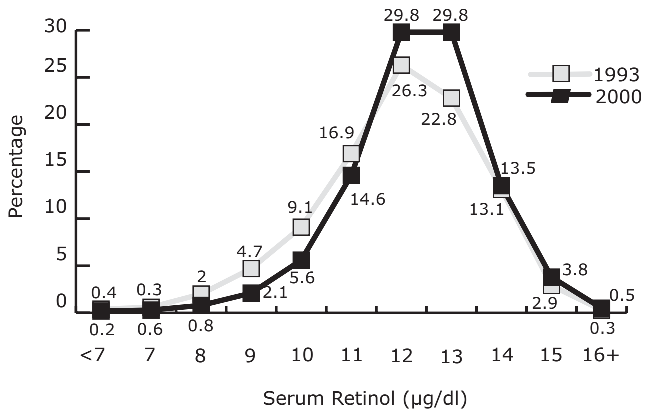


Figure 8. Prevalence of Anemia in Mothers/ Caregivers (Hb <12 g/dl), 1993 – 2000

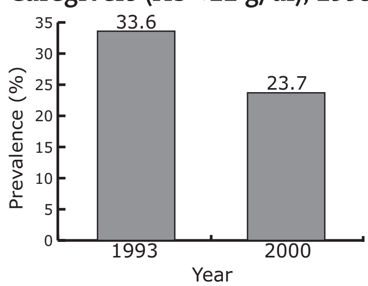


Figure 9. Prevalence of Anemia in Mothers/Caregivers (Hb < 12 g/dl) by Region, 1993 – 2000

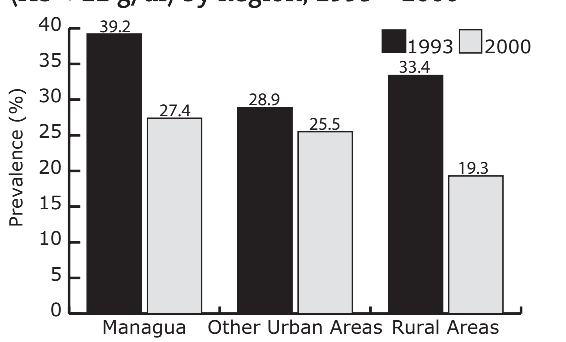
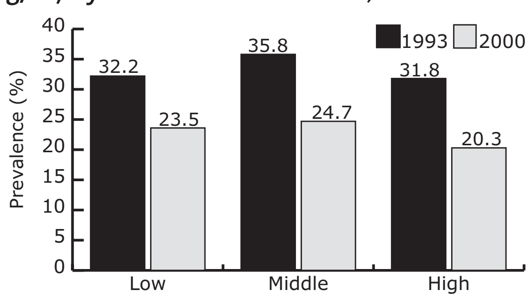


Figure 10. Prevalence of Anemia in Mothers/Caregivers (Hb <12 g/dl) by Socio-Economic Level, 1993 – 2000



by age, decreased from 31.2% to 8.6%, representing a 72% decrease in the rate found in 1993 (Figure 6). The rate of 8.6% excludes children between 6 and 11 months old and the rural Atlantic region (which were not included in 1993), and therefore is slightly lower than the national rate reported in previous sections. The decrease in VAD prevalence in children is observed in all age groups. In 1993, 7.9% of the children had severe vitamin A deficiency (serum retinol < 10 μg/dl) compared with 0.3% in 2000 (Figure 6). The decrease in the percentage of children with retinol concentrations lower than 20 μg/dl occurred in all geographic strata or areas of residence, with the largest decreases in the rural areas and in urban areas other than Managua. VAD in children decreased in the various socio-economic levels.

Anemia in Mothers/Caregivers of Children 12-59 Months

The distribution of hemoglobin levels in mothers/caregivers moved significantly to the right, toward higher values, a shown in Figure 7. There is a noticeable reduction in the prevalence of anemia in mothers/caregivers (hemoglobin < 12 μg/dl), from 33.6% in 1993 to 23.7% in 2000, representing a 29.5% decrease (Figure 8). The 2000 rates exclude mothers/caregivers living in the rural Atlantic region and those of children from 6 to 11 months old, which were not included in NMS-93; therefore, they differ slightly from the rates presented in the previous section.

Anemia rates dropped by 29% in Managua (from 39.2% to 27.4%) and by 42% in rural areas (from 33.4% to 19.3%), with a more modest decrease (11.8%, from 28.9% to 25.5%) in other urban areas (Figure No. 9).

The average hemoglobin level in mothers/ caregivers increased from 11.4 g/dl in 1993 to 12.7 g/dl in 2000. Regardless of socio-economic level, the proportion of anemia in mothers/caregivers decreased (Figure 10).

Figure 11. Distribution of Hemoglobin Levels in Children 12-59 Months, 1993 – 2000

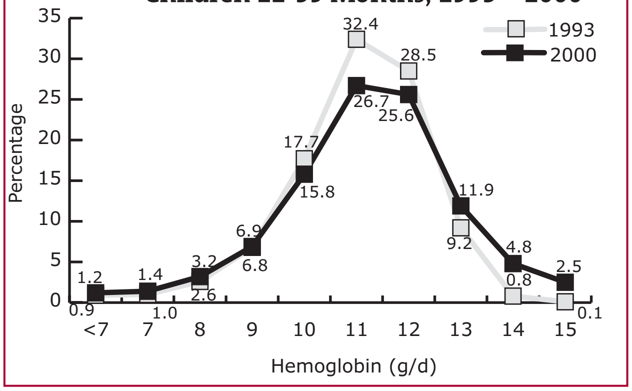


Figure 12. Prevalence of Anemia in Children 12-59 Months (Hb < 11 g/dl), 1993 – 2000

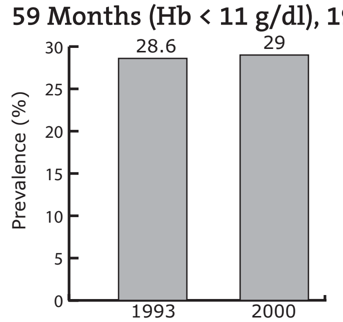


Figure 13. Comparison of the Prevalence of Anemia in Children 12-59 Months (Hb < 11 g/dl) by Urban/Rural residence, 1993 – 2000

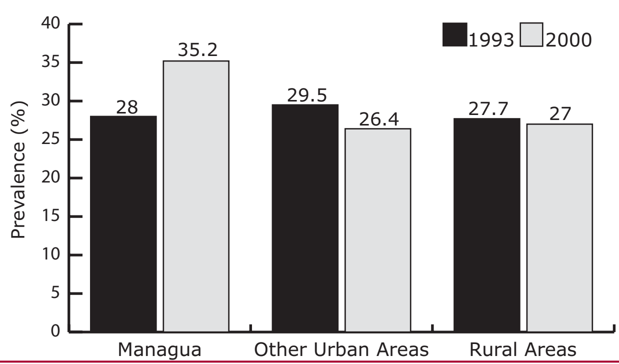
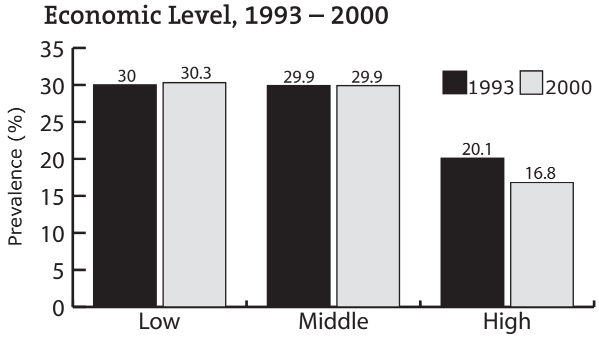


Figure 14. Comparison of the prevalence of Anemia in Children 12-59 Months (Hb < 11 g/dl) by Socio-Economic Level, 1993 – 2000



Anemia in Children 12-59 Months

No significant changes were found in the distribution of hemoglobin for children, although it is slightly less dispersed in 2000, as shown in Figure 11. The national prevalence of anemia in children 12-59 months, weighted and adjusted for age, did not change from 1993 (28.6%) to 2000 (29.0%), a shown in Figure No. 12. The rate of anemia in children 12-59 months in 2000 (29.0%) differs from the one reported in the section about anemia in children 6-59 months (33.5%) as this includes children 6-11 months. Children living in the rural Atlantic region were not covered in 1993 (Figure 12).

In both surveys, the highest rate for anemia was found in the 12 to 23 month age group (55.1% in 1993 and 54.6% in 2000) and the lowest in children 48-59 months (12.7% in 1993 and 10.0% in 2000).

As shown in Figure 13, the rate of anemia in Managua increased significantly compared to that of 1993, from 28% to 35.2% (25.7% higher than the 1993 rate). In 1993, the lowest rate for anemia was observed in urban areas other than Managua (26.4%). Mean hemoglobin, regardless of geographic strata, was somewhat higher in 2000 than in 1993. The overall average increased by 0.9 g/dl, from 10.6 g/dl to 11.5 g/dl.

The association of anemia and socio-economic level of the households was similar in 1993 and 2000 (Figure 14). The highest prevalence was found in children of the lowest socio-economic level (30% in 1993 and 30.3% in 2000) and of middle level (29.9% in both surveys). The lowest incidence and some reduction were found in children of the high socio-economic level (20.1% in 1993 and 16.8% in 2000). Mean hemoglobin somewhat increased in children from the various socio-economic levels over those reported in 1993. However, the prevalence of anemia did not change, with the exception of the small group from the high socio-economic level.

Fortification of Sugar and Salt

Retinol in Sugar

The fortification of sugar with vitamin A began in Nicaragua with the sugar harvest 1999-2000. During the first months of production of fortified sugar, sugar from the previous harvest was still being sold and, as time went on, the non-fortified sugar gradually disappeared from the market, making way for sugar fortified with vitamin A. The samples of sugar obtained in the households that participated in the NMS-00 were mixed together to form a composite sample in each segment of the study, making a total of 220 composite samples.

Analysis of the sugar confirmed that the majority of the samples had some quantity of retinol (Table 14 and Figure 15). The minimum value was zero and the maximum was 19 mg/kg, with an average of 5.4 mg/kg, a standard deviation of 2.65 mg/kg and a median of 5.4 mg/kg. Slightly more than half of the samples (51.9%) had concentrations of retinol between 5 and 9 mg/kg, considered acceptable, and 40.1% were between 1 and 4 mg/kg, or insufficient levels. No retinol was found in 4.8% of the samples and the concentrations of retinol were greater than 9 mg/kg in 4.1% of the samples. The results of the analysis of the sugar samples show that, during the field work period of the survey (January to March 2000), the majority (95%) of the sugar reaching Nicaraguan households was fortified and that, in general, 55.1% of the sugar had adequate levels of vitamin A (>5 mg/kg), but more than 40% did not have sufficient levels.

There was no evidence of important differences in the retinol concentration in sugar between the samples from urban areas and those from rural areas (Table 15). However, the percentages of samples with concentrations of 5 mg/kg and above were slightly higher in the urban areas. Some 41.3% of the urban samples and 48.2% of the rural samples had insufficient levels of vitamin A (< 5 mg/kg).

Figure 15. Retinol Concentrations in Household Sugar Samples

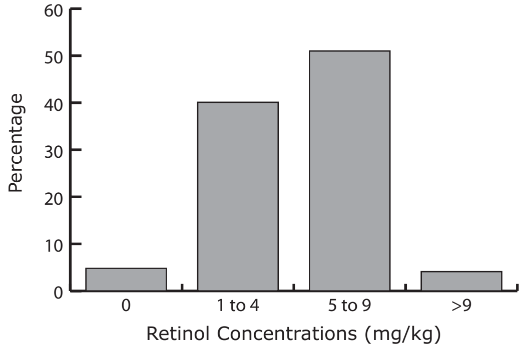


Table 14. Retinol Concentrations in Composite Samples of Sugar From Households, by Region

Retinol Concentrations in Sugar (mg/kg)	Urban		Rural		Total	
	No.	%	No.	%	No.	%*
0	4	2.8	7	6.4	11	4.8
1 – 4	44	38.5	44	41.8	88	40.1
5 – 9	61	54.1	51	48.2	112	51.0
> 9	5	4.6	4	3.6	9	4.1
Total	**114**	**49.8**	**106**	**50.2**	**220**	**100.0**

Weighted percentages*

Table 15. Retinol Concentrations in Sugar Samples from Households

Regions	Average	Mean (mg/kg)	SD	Total (n)
Urban Pacific	4.59	4.55	2.43	41
Rural Pacific	3.85	3.63	2.18	33
Managua	5.28	5.15	2.24	24
Urban Central	6.65	6.46	3.33	33
Rural Central	6.25	6.58	2.58	50
Urban Atlantic	6.20	6.07	1.61	16
Rural Atlantic	5.00	4.87	2.18	23
Total	**5.40**	**5.40**	**2.65**	**220**

The highest averages of retinol in sugar were found in the urban and rural Central regions (6.65 and 6.25 respectively). The lowest average was found in the rural Pacific region (3.85). Retinol content was similar in the urban Atlantic region and Central region, as well as in the rural Atlantic region and the urban Pacific region. The overall mean and median were 5.40 mg/kg.

Iodine in Salt

The salt iodination program in Nicaragua began in the 1980s and has been operating relatively successfully; however, the weakness of the surveillance and control system and temporary shortages of fortificant have affected its quality. The most-consumed brands are: Betsy, Tortuga, Marisela, el Arca, Perla and Libby. The data from this survey indicate a minimum value for iodine in salt of 8 mg/kg and a maximum of 58 mg/kg, with an average of 29.7 mg/kg, a standard deviation of 8.3 and a median of 31 mg/kg. In addition, it was found that only 4.3% of the samples collected in households had levels of less than 15 mg/kg (considered insufficient levels), such that almost 96% of the samples had satisfactory levels (Table 16). Some 44.8% of the samples had values between 15 and 30 mg/kg and 50.9% had values above 30 mg/kg. The technical guideline that was recently approved in Nicaragua establishes a margin between 30 and 60 mg/kg. Only half of the samples complied with this technical guideline. Six out of every ten samples in the urban area of Managua and in the urban Central region were found to have insufficient values (less than 15 mg/kg).

Table 16. Iodine Concentration (mg/kg) in Household Salt Samples

Iodine Level	Number	Percentage*
Less Than 15	10	4.3
15 – 30	99	44.8
More Than 30	112	50.9
Total	**221**	**100**

* weighted percentage

Iodine Situation in Children 6-9 Years

The measurement of iodine concentrations in urine is one of the accepted methods to assess the iodine situation of the population (WHO, 1992). Approximately 80% of total iodine consumed are excreted through the urinary tract, making urinary iodine a reliable indicator for assessing iodine intake. The results of this survey show that the average urinary iodine in school-age children between 6 and 9 years old was 34.5 µg/dl, with a standard deviation of 32.7 µg/dl and a median of 27.1 µg/dl. According to established international criteria for the identification of iodine deficiency disorders, iodine deficiency is not a significant public health problem when the mean for urinary iodine excretion is higher than or equal to 10 µg/dl. The problem is considered severe when the mean is less than 2 µg/dl. Under this premise, iodine deficiency does not currently constitute a significant public health problem in Nicaragua.

The problem is considered to be under control when less than 50% of the urinary iodine samples have values under 10 µg/dl or less than 20% have values under 5 µg/dl. The data in this survey reveal that the national incidence of iodine values under 10 µg/dl was 13.4%, with higher percentages in the rural areas (19.9%) than in the urban areas (9.0%). The proportion of values under 2 µg/dl was 1% and that of values < 5 µg/dl was 4.7%. The highest prevalence of iodine values below 10 µg/dl was recorded in the rural Central region (22.4%) and in the rural Atlantic region (19.7%). The lowest percentages were identified in the urban Central region (7.6%) and in Managua and the urban Atlantic region (7.7%) According to these values, the rural Central, rural Atlantic and Managua regions merit special attention.

Flouride in Children 6-9 Years

It is more practical and economical to determine urinary concentrations of fluoride on a large scale than to do detailed studies on intake and metabolism. The urinary concentrations of fluoride in people that live in temperate climates tends to be analogous to levels in the water consumed by the population when this is its primary contributor. It is recommended that the concentration of urinary fluoride should be at least 1 mg/l after having completed the stabilization period. When the level of fluoride in the water is far below 1 mg/l, its urinary concentration does not decrease proportionally. This difference seems to follow the intake of food or other substances that also contain fluorides. Also, in these circumstances there can be a freeing of fluoride from the osseous system and from other areas inherent to the individual metabolic system.

In this survey, 22.8% of the urine samples collected from children 6-9 years had optimal concentrations of urinary fluoride (0.8 to 1.20 µg/ml), 26.1% had high levels (> 1.20µg/ml) and 51.1% had insufficient levels (< 0.8 µg/ml). In the Managua region, fluoride concentrations were found to be higher than 0.8 µg/ml in 91.7% of the samples and above 1.20 µg/ml in 64.9%, with a close correlation with the results of the study on natural fluoride concentrations conducted in 1997. Some 75.7% of the samples from the Atlantic region and 69.4% from the Central region had fluoride concentrations below 0.8 µg/ml (Table 17). In the Pacific region, 54.6% of the samples had concentrations lower than 0.8µg/ml. Sixty-six percent of the samples from the rural areas had levels below 0.8 µg/ml compared with 37.7% in the urban areas.

Table 17. Concentrations of Urinary Fluoride in Children 6-9 Years, By Geographic Strata

Regions	<0.4	0.4 – 0.7	0.8 – 1.1	1.2 – 1.5	1.6 – 1.9	2.0 & above
Pacific	20.4	34.2	27.1	11.6	3.6	3.1
Managua	2.2	6.1	26.7	15.6	14.4	34.9
Central	34.5	34.9	18.7	8.9	1.3	1.7
Atlantic	49.5	26.2	15.9	6.5	0.9	0.9
Rural	36.5	29.6	21.1	9.4	1.1	2.2
Urban	13.9	24.0	24.5	12.4	8.6	16.8
Total (100%)	**24.5**	**26.6**	**22.9**	**11.0**	**5.1**	**9.9**
N = 750	**(202)**	**(224)**	**(169)**	**(79)**	**(29)**	**(47)**

Discussion

This report summarizes the results of the Second National Micronutrient Survey of Nicaragua which was carried out in 2000, about seven years after the first survey conducted in 1993. In the interim period, a national micronutrient plan with specific policies and programs was implemented in the country. The 2000 survey utilized a larger nationally representative sample of households with children under five years of age that is comparable to the one in 1993, except for the age group 6-11 months and the Atlantic rural area which were not covered in 1993. The content of the survey was expanded in 2000 to include new biological indicators (e.g. AAGP in both children and women, serum retinol in pregnant women, urinary iodine and fluoride in children 6-9 years, nutrient content of fortified foods) and some per-capita intake of selected foods was estimated. A major purpose of the 2000 survey was to update the information on the current situation of micronutrient-related deficiencies (vitamin A, iodine, and anemia) that were previously found to be problems of public health significance in the country.

Vitamin A Deficiency

One of the most outstanding findings of the survey was the dramatic reduction in the levels of vitamin A deficiency in children under five years old compared to 1993. The decrease in VAD rates may be the result of: 1) methodological differences in the two surveys, for example in the sampling frameworks, in the representativity of the samples or in the VAD measuring procedures and techniques; 2) noticeable improvements in income levels and, in general, in the socio-economic conditions and in the infectious morbidity of the population; or 3) the impact of specific programs aimed at improving vitamin A intake in groups at risk of deficiency.

The sampling frameworks in the two surveys were similar as both used random sub-samples of households taken form the national samples covered by the Demographic and Health Surveys (DHS-93 and DHS-98). Although the laboratory methods used for measuring serum/plasma retinol (spectrophotometric in 1993 and HPLC in 2000) are not strictly comparable, it is unlikely that a decrease of this magnitude in the prevalence of values <20 ug/dl could be attributed to differences in the methods. The HPLC method is currently considered the standard for measurement of serum/plasma retinol.

The information available from national statistics and surveys does not offer an indication of noticeable improvements in the income of the population during the period from 1993 to 2000, and does not show evidence of significant positive changes in general socio-economic conditions or in economic access to a more varied and higher quality diet. Further, the data from NMS-00 suggest a possible tendency toward deterioration of the socio-economic situation in that period. There is not data on dietary consumption that allows for an evaluation of whether there have been dietary changes in the population, particularly among children.

Since 1998, a national information, education and communications strategy has been implemented to promote production and the consumption of foods rich in vitamin A, through training of health personnel and the production and distribution of various educational materials for health providers and general population. The impact of this strategy on children's consumption of foods that are rich in vitamin A is not known. On the other hand, relatively high levels of immunization of children have been reached, with a possible reduction in the rates of immune-preventable diseases, which may have contributed to the reduction in the prevalence of VAD. There has also been a moderate but consistent decrease in the prevalence of diarrhea-related illnesses over the last decade (DHS 98).

In response to the results of NMS-93, the MOH, with technical and financial support from various assistance agencies, has been implementing a variety of strategies to reduce deficiencies of micronutrients, including VAD. The latter has been addressed through vitamin A supplementation; a national information, education and communications (IEC) strategy to promote diversity in the diet; and, most recently, through fortification of sugar with vitamin A. A relatively high coverage (over 70%) in supplementation of children under ten years has been sustained since 1994 through twice a year National Health Campaigns. In recent years, the supplementation program has prioritized children under five years old. A long-term impact of sustained high rates of vitamin A supplementation seems to be the most likely explanation for the dramatic decrease in VAD in children.

The research on the effects of high dosage vitamin A supplementation on serum retinol in children has generally been limited to evaluating the biochemical response (serum retinol) to a single dose within some months of its administration. This response has been described as a rapid increase in the serum retinol levels during the first thirty days after supplementation followed by a plateau over the next two to three months and then a rapid decrease to approximately the original levels. This suggests that the effect is short term and tends to disappear over the following four to six months thus the recommendation is to repeat the administration of the supplements every four to six months. It would be expected, however, that the long term behavior of serum retinol in response to supplementation may depend not only on the initial levels and the dosage administered, but also on dietary intake and, as it has been confirmed, on the exposure of the child to infectious morbidity. Unfortunately, the long term impact of repeated doses of vitamin A supplements on serum retinol has not been formally evaluated, nor has the contribution of infectious morbidity been quantified.

The results observed in Nicaragua seem to contradict the concept that the effect of supplementation is short term and does not persist after four to six months. However, it may be hypothesized that repeated high doses of supplements every six months may progressively increase vitamin A reserves and serum retinol such that the level reached before each new administration of the supplement is higher each time. This explanation would be supported by the finding of higher serum retinol levels (lower incidence of deficiency) among children who received supplements in the last three months and the absence of differences among those that received supplements more than four months before the measurement. This hypothesis can only be confirmed with controlled studies. The gradual decrease of infectious morbidity in children, although modest, may have also contributed to increase serum retinol levels, although there was not a similar effect observed with hemoglobin levels in children.

The possibility of an effect of sugar fortification may be discarded in great measure as, at the time of the survey, the program was just beginning and gradually improving its quality, so it is very likely that the length of exposure of the population to the fortified product was insufficient to modify the levels of serum retinol. The initial evaluation of the impact of the fortification of sugar with vitamin A on serum retinol levels in Guatemala used biannual measurements thus it did not establish whether changes may occur over shorter terms. When this survey was conducted, fortified sugar was just beginning to reach consumers and, although it was reaching the majority of the population with increasing levels of quality, it cannot be considered as a significant factor in the decrease of VAD rates. However, it is expected that, in the future, fortification will further increase and maintain retinol levels, generating a gradual decrease in the need for supplementation, with the exception of children under two years old. Fortification may be a more sustainable measure over the long term.

For the first time in Nicaragua, vitamin A deficiency in mothers/caregivers was studied, with encouraging results as the VAD rates are low. The lack of prior information prevents us from establishing tendencies. The findings of this survey do not clarify this as the situation of the mothers/caregivers is similar to that of the children, even when the former do not systematically receive vitamin A supplements as the children do. An important factor is that the rate of infection in mothers/caregivers is generally lower than in children, as confirmed by the AAGP results. In 1998, the Ministry of Health (MOH 1998) established vitamin A supplementation guidelines for postpartum mothers/caregivers over the first four weeks of the postpartum period; however, the coverage of this supplementation is very low. Currently the MOH does not have a monitoring system and the reasons for poor compliance with the guidelines by the health units that offer delivery and postpartum care services are not known. On the other hand, 65% of births are attended on an institutional level (DHS 98) and a third are attended in the home, by either midwives or family members. Therefore it should be possible to achieve high levels of coverage of vitamin A supplementation coverage in the immediate postpartum period.

Anemia

Among the most important findings of this survey is the significant decline in the overall incidence of anemia in mothers/caregivers and the absence of changes in the anemia rate among children compared with the 1993 rates. The explanation for the improvement in the anemia rate for mothers/caregivers may be examined in the same way as the decrease in VAD in children. The factors to consider are: 1) methodological differences in the 1993 survey and the 2000 survey; 2) changes in income levels and in the socio-economic conditions and in the infectious morbidity of the population; and 3) the potential impact of programs aimed at controlling anemia.

It has already been noted that the sampling frameworks and designs of the two surveys are comparable; further, the methodology for the measurement of hemoglobin was the same in the two surveys, in other words, both used the HemoCue to measure hemoglobin in a drop of venous blood taken with a Sardstead tube and transferred directly to a HemoCue microcuvette. On the other hand, as was already mentioned, there is not any evidence of an increase in income or of significant socio-economic changes in the population nor in dietary practices. Therefore, the most likely explanation is related to the programs for anemia control that have been implemented in the interval between the two surveys. These include iron supplementation for pregnant women and for children under five years old, the fortification of wheat flour with iron and B-complex vitamins, and the regular treatment of children for parasites.

Due to the absence of an effective monitoring and evaluation system, there is no accurate data on coverage of iron supplementation. According to the 2000 survey, about 70% of the mothers/caregivers that had been pregnant in the year prior to the survey reported having received iron supplements during the pregnancy.

Although information about the quantities of supplements received and consumed is not available, it can be assumed that the actual rate of supplementation during pregnancy is relatively high and, it seems that the majority of mothers/caregivers take the supplements regularly. The same does not occur with the children, of whom only 37% reported having received some iron supplement in the previous six months with the majority only receiving one bottle (supposedly for one month of supplementation), an compliance is not known.

The universal fortification of wheat flour began in 1998 and seems to be operating effectively according to partial data from the monitoring system of the Division for Food Control of the MOH, although the low bioavailability of the iron compound currently used (reduced iron) is likely to reduce its impact on iron intake and anemia control. Eighty-six percent of the families state that they consume bread or sweet bread on a regular basis, although in relatively low amounts (average 22 grams per person/day, median 9 grams). It is assumed that the volume for children is much lower. The impact of fortification may increase in the future with the use of an iron compound with greater bioavailability.

On the other hand, the proportion of mothers/caregivers of childbearing age that use contraceptive methods increased from 40% to 60% (DHS 98), which suggests less frequent pregnancies and a possible increase in the birth interval, thus decreasing the risk of anemia in mothers/caregivers. The overall fertility rate decreased from 4.6% in 1993 to 3.9% in 1998 (DHS 98). Also, the oral gestagens used by 14% of the mothers/caregivers tend to regulate the cycle and the duration of bleeding, and, in addition contain seven tablets of ferrous sulfate that the mothers/caregivers theoretically take at the end of the cycle of pills. Progesterone-based contraceptive pills such as Depo-Provera frequently cause amenorrhea and, therefore, reduce blood losses, although they are used only by 5% of the mothers/caregivers.

Based on the above considerations, it is very likely that the reduction in the anemia rate in the mothers/caregivers is the result of the combined effects of supplementation during pregnancy and wheat flour fortification along with a possible contribution from the increased use of oral contraceptives and decreased pregnancy rate. At the same time, the absence of changes in children despite regular treatment for parasites through the National Health Campaigns, may be attributed to coverage and quality deficiencies in iron supplementation, especially in the first two or three years of life, and to the relatively low consumption of foods prepared with fortified wheat flour.

In 1998, the Ministry of Health issued and disseminated new guidelines for iron supplementation to prevent and treat anemia in children and in pregnant mothers/caregivers. The iron supplements must be provided free of charge in the Prenatal Care and Integral Children's Health Care Programs of the health services of the MOH. Iron supplementation, if practiced efficiently and with high coverage, is a cost effective measure with short term impact for the prevention and treatment of anemia due to iron deficiency in children and in mothers/caregivers. It seems that the irregular availability (MI, 2001) of iron supplements in the health units, due to insufficient and erratic supply, is an important factor in the lack of improvement in anemia in children. It is very important to establish the reasons for not having an adequate and timely supply and distribution of iron supplements for the high risk groups, children and pregnant women.

Recently anemia studies were conducted on small samples. In 1997, the University of Nicaragua (UNAN-Managua) conducted a study of iron supplementation for mothers/caregivers of childbearing age residing in four sectors of the department of Managua, finding that 40.6% of 1939 mothers/caregivers had anemia (Miranda & Wallace, 1997). A studied in the late 1990s by the MOH, UNAN-Managua, CIES and OMNI/USAID on a sample of 600 children under one year old found a national rate of anemia of 71.3% (hemoglobin < 11 g/dl) and an overall hemoglobin average of 10.26 g/dl. Nevertheless, the cut-off used (<11 g/dl) does not seem appropriate for this age group, especially for those children under six months old. In June 2000, Project Hope studied 360 children under two years of age in the department of Chontales and reported a 49.4% prevalence of anemia. The average hemoglobin level was 10.99 g/dl.

An important finding of this survey is the general acceptance of iron supplements by mothers/caregivers, although there was no specific evaluation of compliance with dosage. The UNAN study in 1997 showed that only 3.1% of the mothers/caregivers abandoned the supplements although 40% reported some type of undesirable side affect from taking iron (Miranda and Wallace, 1997). However, mothers/caregivers compliance in administering iron supplements to their children, frequency of side effects and rates of treatment suspension haven't been documented. In addition to the need to ensure the continued availability of iron supplements in the health services, strategies must be considered to enhance the effectiveness of supplementation through better training/knowledge of health personnel and actions for improving compliance and preventing and eventually managing side effects.

There are various determining factors for anemia in children (MI, 1998). In addition to iron deficiency, parasites may also play an important role, especially hookworm and malaria, as well as other nutritional deficiencies and dietary factors that inhibit the absorption of iron. Treatment for parasites and control of malaria are included in the National Micronutrient Plan as collateral activities that should be promoted to prevent anemia. In addition, guidelines for treatment of parasites are included, e.g. as part of Integrated Management of Childhood Illnesses (IMCI), and are undertaken periodically in the National Health Campaigns to assure greater coverage. As with the iron supplements, the anti-parasite and anti-malarial medications are included in the basic list of medicines. The impact of periodic treatment of parasites in the National Health Campaigns on the rates of parasites in children has not been evaluated.

The baseline survey for the information, education and communications campaign on micronutrients found that almost half (47%) of children drink coffee, with an average consumption of eight times per week. More than half of pregnant women (54%) was also coffee drinkers. These findings suggest the need for communication and education actions to discourage simultaneous consumption of coffee with supplements and foods, both in children and in mothers, in order to improve iron absorption. Sixty-nine percent of children and pregnant women consume lemons, although with less frequency than coffee (4.5 times per week). Higher percentages mentioned the consumption of oranges (86% of children and 80% of pregnant women). The intake of lemons and oranges and other citrus fruits facilitate the absorption of iron.

Iodine and Flouride Deficiencies

Iodine deficiency is largely under control in Nicaragua through iodination of salt. In 2000, urinary excretion of iodine (median 271 ug/dl) was well above the internationally recommended cutoff point (100 ug/dl). However, 13.4% of the population was still at risk for the deficiency, with urinary iodine levels at less than 10 μg/dl, and almost half of the salt samples nationally had iodine levels below the recommendation. This suggests a need for continuing to strengthen the iodination of salt and assure its sustainability over the long term, as well as, eventually, for reducing mandatory levels of iodine in salt. Both the urinary fluoride excretion results of this survey and the results on fluoride content in water for consumption from previous studies showed a great variation in the fluoride situation, with marked regional differences. Nationally, there was a high proportion of the population (more than half) with deficient levels of urinary fluoride excretion, while a large percentage (21%) had above normal levels. In addition, the fluoride situation was significantly different in Managua than in other regions, particularly the Atlantic and the Central regions.

The National Oral Health Program of the Ministry of Health, in coordination with the National Nutrition Program, was establishing a base line to assess the viability of a program to fortify salt with fluoride as a massive, low-cost, highly effective preventative measure to reduce the incidence and prevalence of dental caries, especially in children. Fluoride rinses have worked relatively well in Nicaragua over the last two decades, and are applied to schoolchildren from six to fifteen years old in public schools, basically in the urban areas.

Conclusions

The National Micronutrient Survey of 2000 provided a view of the current situation of the most important micronutrient deficiencies in the country, that is, vitamin A deficiency (VAD), anemia due to iron deficiency, and iodine deficiency disorders (IDD). In addition, it contributes important information about the coverage of some of the programs for the control of these deficiencies. It also allowed an examination of changes that have occurred in the magnitude of these deficiencies since the National Micronutrient Survey of 1993. In general terms, a marked reduction was observed in the prevalence of VAD in children, as well as low rates in mothers/caregivers of childbearing age. A moderate decrease in the rate of anemia in mothers/caregivers was also found, while the rate for children remained stable. IDD appeared to be temporarily under control thanks to the salt iodination program, although this hadn't yet reached the levels necessary for the virtual eradication of these disorders.

The positive tendency in the vitamin A levels in children may be reasonably attributed mainly to the high coverage of vitamin A supplementation, on a sustained basis, through the National Health Campaigns, as well as to the reduction of infectious morbidity. On the other hand, the decrease in the rates of anemia for mothers/caregivers may be mainly attributed to a relatively high coverage of iron supplementation during pregnancy and consumption of products made with fortified wheat flour. A similar effect was not observed in children, possibly due to insufficient intake/absorption of fortified products and low coverage rates of iron supplementation. More specifically, the results of the survey led to the following conclusions:

The coverage of vitamin A supplementation in the six months prior to the survey, based on the responses of the mothers/caregivers, reached close to two thirds of the children. Most of this coverage was through the second National Health Campaigns of 1999, even though only slightly more than one third was recorded on the comprehensive child health care card. In the year prior to the survey, only one out of every ten postpartum mothers/caregivers received a vitamin A supplement in the postpartum period. During this same period, seven out of every ten pregnant women received iron supplements. There was almost general acceptance of iron supplements by mothers/caregivers. The coverage of iron supplementation of children was very low. Vitamin A and iron supplements were mostly supplied by the Ministry of Health services.

One out of every ten mothers/caregivers had VAD, with almost double the prevalence in the urban areas compared to the rural areas. The highest rate was observed in Managua. VAD in mothers/caregivers was related to VAD in children and the mothers/caregivers with VAD also had a greater tendency to be anemic. No association was found between VAD in mothers/caregivers and their age, their level of schooling, their work situation, their socio-economic situation, the sex of the head of household, whether they were pregnant the year prior to the survey, iron supplementation during their last pregnancy or anemia in their children.

One out of every eleven children had vitamin A deficiency, which was slightly more frequent in urban children than those in the rural areas. Managua had a higher prevalence. The highest prevalence of VAD was seen in the youngest children, from 6 to 11 months old, with a clear tendency to decrease with age. The prevalence was lower in children that had received vitamin A supplements in the three previous months. No association was found between VAD in children and the age of the mother/caregiver, her level of schooling, her work situation or her socio-economic situation. However a relation was found between anemia and VAD in children and between anemia in the mothers/caregivers and the prevalence of VAD in children. In general, considering the criteria recommended by the WHO, VAD constituted a low level public health problem in Nicaraguan children from 6 to 59 months old in the year 2000. According to most recent IVACG recommendations, VAD may not longer be considered a problem of public health significance in Nicaragua.

The prevalence of anemia in mothers/caregivers also improved substantially across all socio-economic strata, age groups and geographic areas, with a larger reduction in the rural areas. At least two of every ten Nicaraguan mothers/caregivers of childbearing age had anemia. The highest prevalence was found in the urban and rural Atlantic regions, in which between three and four of every ten mothers/caregivers were anemic. About one third of pregnant mothers/caregivers were found to be anemic. No relationship was found between anemia in non-pregnant mothers/caregivers and their age, origin, level of schooling, work situation, pregnancy in the year prior to the survey or socio-economic level.

The situation of anemia in children from 12 to 59 months old did not improve compared to 1993, and the highest proportion continued to be seen in children from 12 to 23 months old. The prevalence of anemia was higher in children than in their mothers/caregivers: one of every three children was anemic. As with the mothers/caregivers, the urban and rural Atlantic regions had the highest rates. The anemia rate was very high for children from 6 to 11 months old and decreased as age increased. Children from households with greater numbers of children under five years old had a significantly higher rate of anemia. A significant relationship was found between anemia and the age of the child, the level of schooling of the mothers/caregivers, the socio-economic level, the presence of diarrhea in the two weeks prior to the survey, a history of having taken vitamin A supplements and anemia in the mothers/caregivers. No significant relationship was identified between anemia in children and the geographic strata, the sex of the head of household, age or the work situation of the mothers/caregivers. The rate of severe anemia in children was below one percent, with the urban Atlantic and the Managua regions being the most affected, as were children between 6 and 23 months of age.

The results of this survey confirmed the progress reached in the control of iodine deficiency, as well as the need to strengthen the salt iodination program and to take the measures necessary to assure its sustainability and avoid interruptions in quality and continuity that put the achievements at risk and delay compliance with the desired goal of virtual eradication of iodine deficiency disorders. The fluoride situation was somewhat more complex as there was a high risk for deficiency in a large proportion of the general population while one out of every five people was at risk for excessively high levels of fluoride. This situation must be considered in the planning of actions to reduce the high rate of dental caries in order to address the risk of both deficiency and excess.

Recommendations

Based on the findings of this survey and in comparison with the similar survey conducted in 1993, the following general recommendations were proposed:

1) **This report should be extensively disseminated** among all national, regional and local public institutions, particularly to the public health sector, as well as to the private sector and the general population, in order to increase the level of awareness about the problems identified, their tendencies and the need to maintain policies and actions that have been effective, optimize others and design new options to resolve persistent problems.

2) **The results of the survey should be broadly used** in the context of the evaluation of the National Micronutrient Plan 1996 – 2000 and the design of the new five year plan, 2001 – 2006 which the national government intends to formulate, through the National Micronutrient Commission and the Ministry of Health, in order to consolidate the achievements and to accelerate the control of micronutrient and other deficiencies that may still persist.

3) It was recommended that the results of the survey and of the final evaluation of the 1996 – 2000 National Micronutrient Plan be used systematically for pertinent **policy and program decision-making**, and for the development of the new 2001 – 2006 National Micronutrient Plan. The most important policy and program decisions should primarily focus on:

   a. The establishment of **new health and nutrition priorities** based on the observed trends and the current situation of micronutrient deficiencies; for example, priority regions and age groups based on current rates, vulnerable groups and magnitude of damage.

   b. The need to **substantially strengthen some program**s that thus far have not achieved expected coverage and effectiveness, such as:

      » The **anemia control program**, through revision of technical guidelines for iron supplementation; prioritization of children under two years old; strengthening the supply, distribution and demand of supplements; strengthening fortification of wheat flour; establishment of fortification of other foods with iron and B-complex vitamins; training of health care personnel and community volunteers; establishment of community volunteer networks (brigadistas, midwives) to distribute iron supplements to pregnant women and children; education and counseling on the appropriate use of supplements; monitoring of adherence to treatment and suitable management of side affects.
      » The **salt iodination program** and the monitoring and quality control systems for fortified foods in general.
      » Systematic **vitamin A supplementation** of children under two years old in the regular health services and National Health Rallies.

   c. Consideration of the convenience and potential effectiveness of **new policies and programs**, including encouraging and regulating voluntary fortification of foods and mandatory fortification of corn flour.

4) The possibility and convenience of **refocusing certain programs** on the groups that continue to be exposed to a high risk of deficiencies, for example, iron and vitamin A supplementation of children under two years old, who are less likely to benefit from the fortification of sugar and wheat flour.

5) **Evaluation of the effectiveness of social communications strategies** on micronutrients in the achievement of desired changes in the behavior of the target population, both in terms of dietary changes and in greater demand and adherence to dosage of iron supplements. Social communications strategies should contribute to raising awareness, among government and private health care providers, of the situation of micronutrient deficiencies and the importance of prevention, early detection and adequate treatment. They should also address changes in dietary behavior within economic limitations, to obtain greater diversity in the consumption of foods and to create conditions to encourage the voluntary fortification of foods.

6) Development and establishment of an **Integrated System for Monitoring and Evaluation of Nutritional Interventions** that, by using process/outcome and nutritional surveillance indicators, may provide information for periodically evaluating the coverage and quality of the programs as well as their biological impact on the target population. In addition, it is important to better define the nutrition indicators obtained through the National Family Health Surveys. The integrated monitoring and surveillance system should be linked into the information system that the MOH currently uses, including the systematic recording of information on vitamin A and iron supplementation on the children's immunization record card and in the consolidated records of the health services, as well as the collection, analysis and timely use of information on nutrition indicators to guide policy and programmatic decision-making.

Bibliography

Erickson, S.Y., Blood Plasma and Fluoride. An Indicator of Skeletal Fluoride. IRC 1973.

Estupiñan-Day Saskia et al Epidemiological Surveillance of Oral Health in Salt Fluoridation Programs. WHO. Washington, DC 1994.

Filtean SM, Morris SS, Abbott RA et al. Influence of Morbidity on Serum Retinol in a Study in N. Ghana. Am J Clin Nutr 1993; 58:192-197.

Instituto Nacional de Estadisticas y Censo. National Living Standards Measurement Survey. LSMS 1998. Nicaragua.

Nutrition Institute of Central America and Panama, Ministry of Health. Evaluación Nutricional de la Población de Nicaragua. Nicaragua, 1969.

The Micronutrient Initiative. Expert Consultation on Anemia Determinants and Interventions. 1998.

The Micronutrient Initiative. Estudio de Caso, Programa Nacional para el Control de la Anemia. Nicaragua. 2001.

Ministry of Health. First National Micronutrient Survey. Nicaragua, 1993.

Ministry of Health. Encuesta Nacional de Bocio. 1990.

Ministry of Health. MAS, OMNI/USAID, UNICEF. Estudio de Base para la Campaña de Información, Educación y Comunicación en Micronutrientes. 1998.

Ministry of Health. Estudio de Concentración de Fluor Natural en Agua de Consumo Humano de Nicaragua. 1997.

Ministry of Health. Estudio Epidemiológico de Salud Bucal en Niños(as) de 6, 7, 8, 12, 15 de Escuelas y Colegios Públicos De Nicaragua. 1997.

Ministry of Health, OMNI/USAID, UNICEF. Manual de Micronutrientes, Hierro y Vitamina A. 1998.

Ministry of Health, Plan Nacional de Micronutrientes. Nicaragua. 1996 - 2000.

Miranda and Wallace, C. Iron Supplementation Through Community Health Workers. Managua, Nicaragua. 1997.

Moraga, D. et al. Estudio Nutricional Férrico y de Vitamina A en Embarazadas de Área de Salud 6, Region IV, Nicaragua, 1989.

Navas, et al. Yodación de la Sal. Nicaragua 1997.

Noguera, A, et al. Evaluación del Impacto de la Yodación de sal en Nicaragua. Ministry of Health, 1981.

WFP. Analysis and Cartography 2001-10-16.

Sahanon I.I., Sander D.M. Urinary Fluoride Concentration in 6 to 9 Year Old Children Drinking Water of Very Low Fluoride Level. Caries Research, 14. 18-22, 1977.

WHO, UNICEF, ICCIDD. 1992. Indicators for Assessing IDD and Their Control Through Salt Iodization.

The Government of Nicaragua has paid special attention to micronutrient deficiencies, particularly those of vitamin A, iron, and iodine, since the 1993 National Micronutrient Survey. This summary report of the subsequent 2000 survey provides information about the evolution of these deficiencies, which are considered to be significant public health problems in Nicaragua.